

## **ECONOMIC IMPACT ANALYSIS**

### **Criteria For The Certification And Re-Certification Of The Waste Isolation Pilot Plant's Compliance With The U.S. Environmental Protection Agency's Radioactive Waste Disposal Standards (40 CFR part 194)**

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**Office of Radiation and Indoor Air  
U.S. Environmental Protection Agency  
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## **EXECUTIVE SUMMARY**

The purpose of this economic impact analysis (EIA) is to identify the significant costs that may be imposed by the U.S. Environmental Protection Agency's (EPA) rule at 40 CFR part 194, which establishes criteria to be used by EPA to evaluate the Waste Isolation Pilot Plant's (WIPP) compliance with radioactive waste disposal standards established by 40 CFR part 191. Most of the cost-generating activities required by 40 CFR part 194 -- principally data development and analysis -- are already required to be undertaken by other federal regulations. These other regulations include EPA's final radioactive waste disposal standards at 40 CFR part 191, hazardous waste regulations under the Resource Conservation and Recovery Act, Department of Transportation regulations, and Department of Energy (DOE) Orders.

Among the provisions of 40 CFR part 194, only consideration of drilling events in performance assessments is found to have the potential to impose significant costs on the WIPP program. Based on a rough estimate of overall WIPP compliance assessment costs, the worst-case cost impact due to consideration of drilling events is estimated to be in the vicinity of \$29 million. The estimated total projected cost of the overall WIPP program is approximately \$8 billion (DOE 90d). Thus, the high-end cost impact of 40 CFR part 194 is estimated to be less than one percent of the total cost of the WIPP program.

The costs of meeting the provisions of 40 CFR part 194 have been estimated to the extent possible based on a current understanding of DOE plans and procedures. These costs do not appear to meet the definition of significant regulatory action in Executive Order 12866, which requires a regulatory impact assessment for regulations with a potential annual cost impact on the economy of \$100 million. Therefore, there are no plans to prepare a regulatory impact assessment for 40 CFR part 194.

# **CHAPTER 1**

## **INTRODUCTION**

This Economic Impact Analysis (EIA) is divided into three chapters. Chapter 1 provides a brief description of the regulatory background associated with the EIA, and discusses the methodology employed in the analysis. Chapter 2 discusses, on a section-by-section basis, the potential incremental costs attributable to 40 CFR part 194. Chapter 3 assesses the overall incremental costs to the WIPP program resulting from the promulgation of 40 CFR part 194.

### **1.1 OVERVIEW**

This EIA addresses the U.S. Environmental Protection Agency's (EPA) 40 CFR part 194, *Criteria for the Certification and Re-certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR part 191 Disposal Regulations*. 40 CFR part 194 is being developed under the authority of the Waste Isolation Pilot Plant Land Withdrawal Act of 1992 (WIPP LWA) (Pub. L. 102-579, 106 Stat. 4777).

The U.S. EPA is responsible for developing generally applicable environmental standards for the management and disposal of spent nuclear fuel, high-level and transuranic (TRU) radioactive waste. To this end, EPA promulgated standards on August 15, 1985 (40 CFR part 191) (EPA 85). In 1987, however, following a legal challenge, those sections of the standards dealing with disposal (Subpart B) were remanded to the Agency for further consideration by a U.S. Court of Appeals. The WIPP LWA reinstated those sections of the 1985 disposal standards not specifically remanded by the court. On December 20, 1993, EPA issued final amendments to 40 CFR part 191 addressing the remanded sections, i.e., the individual and ground-water protection requirements. Section 8(c) of the WIPP LWA instructs the EPA Administrator to issue criteria for certifying compliance with the final

disposal regulations (hereinafter referred to as 40 CFR part 191), and it is this mandate that will be carried out by 40 CFR part 194.

This document identifies whether costs are due to complying either with the provisions of 40 CFR part 194 or with those of previously issued regulations or directives. All costs of disposal that are attributable to 40 CFR part 191, DOE Orders, or other applicable regulatory requirements will not be attributed to 40 CFR part 194. The methodology for evaluating potentially significant costs attributable to 40 CFR part 194 is discussed below.

## **1.2 METHODOLOGY**

The compliance criteria established by 40 CFR part 194 describe how EPA will assess whether or not the WIPP disposal system complies with the disposal standards found in 40 CFR part 191. The criteria also identify the type and breadth of information that applications for certification and re-certification of compliance must contain. The potential economic impact of these criteria consists of (1) the costs of acquiring, analyzing, and verifying the required data, and (2) the costs of assembling and presenting the information to EPA.

For purposes of this analysis, it is assumed that the latter costs, related to the physical assembly and presentation of the compliance applications, are negligible. The former costs, associated with the development and analysis of data to demonstrate compliance, may be relatively high. However, a substantial portion of this information would have to be developed for the WIPP independent of 40 CFR part 194. Some information is required by other EPA regulations, some by internal DOE Orders, and some by regulations or policies of other agencies and advisory organizations, such as the U.S. Nuclear Regulatory Commission (NRC), the Department of Transportation, and the International Commission on Radiological Protection (ICRP). In fact, much of the required information has already been assembled, and would not have to be regenerated to comply with 40 CFR part 194.

The central question of this EIA is whether the requirements of 40 CFR part 194 add substantially to the cost of the activities that DOE would have to undertake to demonstrate compliance with the containment requirements of 40 CFR part 191. At present, there is no official estimate of the latter cost, due to uncertainties in the WIPP program. Thus, the incremental costs imposed by 40 CFR part 194 can only be roughly approximated.

The initial assessment by EPA of costs attributable to 40 CFR part 194 suggested a worst-case estimate of \$20 million as a result of certain provisions discussed below in Chapters 2 and 3 (EPA 95). Subsequently, a decision-making tool was released by the Department of Energy that calculates the probability that a given combination of activities (e.g., engineered barriers) would enable the WIPP to comply with the containment requirements of 40 CFR part 191, as well as the cost associated with those activities (SNL 95). It is beyond the scope of this EIA to assess the legitimacy of the assumptions and data that form the basis of the tool. For the purpose of this analysis, however, it provides a general framework in which to discuss the potential costs associated with demonstrating compliance with containment requirements.

DOE identified an activity set with a high probability (0.96) of demonstrating compliance that would cost an estimated \$29 million over 1.6 years. There may in fact be activity sets that have lower costs and even higher probabilities of demonstrating compliance, but this determination depends upon further analysis of the tool by DOE. This EIA assumes that \$29 million reasonably represents a high-end cost estimate, and uses it as the reference point for discussing costs attributable to 40 CFR part 194. Because this figure is well below the threshold established by Executive Order 12866 of a \$100 million annual impact on the economy, a regulatory impact analysis was not deemed necessary. The term “significant,” as used in this document in reference to cost impacts, means that the cost in question could potentially equal or exceed \$29 million.

## **CHAPTER 2**

### **ANALYSIS OF INCREMENTAL EFFECTS BY SECTION**

This Chapter examines each section and subsection of EPA's 40 CFR part 194. It identifies which provisions of the rule impose new requirements, and which simply codify existing practice or reiterate existing regulations.

#### **2.1 SUBPART A -- GENERAL PROVISIONS**

The General Provisions of 40 CFR part 194 are mainly informational in nature. They describe the purpose and scope of the regulation, define terms, specify dates, and impart a range of administrative information. This Subpart imposes no significant costs. The various sections are as follows:

##### **2.1.1 Section 194.1: Purpose, Scope and Applicability**

This section cites the authority for 40 CFR part 194 and states its purpose.

##### **2.1.2 Section 194.2: Definitions**

This section defines terms and abbreviations specific to 40 CFR part 194.

##### **2.1.3 Section 194.3: Communications**

This section informs parties where to address communications and sets forth signatory requirements.



#### **2.1.4 Section 194.4: Conditions of Compliance Certification**

This section describes the circumstances and procedures under which a certification or re-certification might be modified, suspended, or revoked.

#### **2.1.5 Section 194.5: Publications Incorporated by Reference**

This section cites specific documents and tells where they can be inspected.

#### **2.1.6 Section 194.6: Alternative Provisions**

This section describes how the provisions of the regulation can be changed.

#### **2.1.7 Section 194.7: Effective Date**

This section sets the effective date for this rule.

### **2.2 SUBPART B -- COMPLIANCE CERTIFICATION AND RE-CERTIFICATION APPLICATIONS**

The first three sections of Subpart B (194.11 - 194.13) are administrative in nature, while the final two sections (194.14 - 194.15) address the content of the original certification application and subsequent, periodic applications for re-certification. This subpart imposes no significant incremental costs.

#### **2.2.1 Section 194.11: Completeness and Accuracy of Compliance Applications**

This section calls for the submission of a complete and accurate application before the compliance certification or re-certification process may begin.

### **2.2.2 Section 194.12: Submission of Compliance Applications**

This section requires submission of 30 copies of any compliance applications and accompanying materials.

### **2.2.3 Section 194.13: Submission of Reference Materials**

This section allows materials to be incorporated into applications by reference, with specific conditions.

### **2.2.4 Section 194.14: Content of Compliance Certification Application**

This section specifies the content required for the original certification application as follows:

#### **Disposal System Description**

The natural and engineered features that may affect the disposal system's performance must be described. A detailed description of the system is normally regarded as a requirement of any Environmental Impact Statement (EIS) prepared under the National Environmental Policy Act of 1970 (NEPA) and regulations promulgated by the Council on Environmental Quality, 40 CFR parts 1500 - 1508 (CEQ 86). The Final Environmental Impact Statement (FEIS) (DOE 80) published by DOE, and subsequently amended through a Supplemental Environmental Impact Statement (SEIS) (DOE 90b), contains much if not all of the information required by Subpart B of 40 CFR part 194, as does the Final Safety Analysis Report (WP 02-9, Rev. 0) (DOE 89b). In addition, DOE Order 6430.1A, "General Design Criteria" (DOE 89c), mandates the preparation of much of the same information. The requirements of 40 CFR part 194 requirements relative to these other documents are examined below.

*Location* -- The location of the disposal system and controlled area is shown in the SEIS, Section 2.1.

*Geology and Other Scientific Areas* -- Descriptions of the geology, geophysics, hydrogeology, hydrology, geochemistry, climatology, and meteorology of the disposal system and its vicinity are required, as well as changes expected in these conditions over the regulatory time frame. The required projection of conditions over the regulatory period is presented in Section 5.4 of the SEIS, Decommissioning and Long-Term Performance, and elsewhere.

*Pathways* -- The presence and characteristics of potential pathways for transport of waste from the disposal system to the accessible environment, are summarized in Section 5.2 of the SEIS and described in detail in the SEIS, the FEIS, and numerous other documents.

Although this basic information may need to be revised and reorganized for purposes of the compliance certification application, the cost of such revision is not likely to be significant.

## **System Design Description**

The design of the disposal system must be described in terms of its construction materials and the codes and standards applied to it.

*Construction Information* -- Information on materials of construction should include, at a minimum, geologic media, structural materials, engineered barriers, general arrangement, and approximate dimensions. Such information is present in numerous DOE design documents (e.g., "WIPP Conceptual Design Report," SAND77-0274 (SNL 77)) and summarized in Section 8, "The WIPP and Its Operation," of the FEIS.

*Computer Codes and Standards* -- The computer codes and standards applied to the design and construction of the disposal system are required to be described. DOE Order 6430.1A, Section 0106 (DOE 89c), lists 43 pages of codes and standards generally applicable to DOE General Design Criteria, and each specific section of the Order states relevant codes. Although a comprehensive listing of such codes for the WIPP has not been obtained by EPA, such a compilation is unlikely to be onerous and any incremental costs attributable to 40 CFR part 194 will not be significant.

## **Assessment Results**

Applications for certification of compliance must include the results of assessments performed pursuant to 40 CFR part 194. A description of input parameters associated with such assessments and the basis for selecting those input parameters must also be included. These requirements are derived directly from 40 CFR part 191. For example, Section 191.13 states that, based upon performance assessments, disposal systems shall be designed to provide a reasonable expectation that cumulative releases of radionuclides to the accessible environment shall not exceed certain limits with certain probabilities. The term “performance assessment” is defined by 40 CFR part 191 to mean an analysis that (1) identifies processes and events that might affect the system, (2) examines the effects of these processes on the performance of the system, and (3) estimates the cumulative releases of radionuclides.

Reporting the results of assessments in the compliance certification application does not generate significant costs per se. However, requirements in 40 CFR part 194 that affect the conduct of such assessments -- specifically, performance assessments -- may be associated with significant costs (see Chapter 3 below).

## **Assurance Requirements for Disposal**

Section 194.14 calls for evidence that disposal of waste will be conducted in accordance with the assurance requirements of 40 CFR part 194. These provisions concern active and passive institutional controls, monitoring, engineered barriers, consideration of the presence of resources and removal of waste. Again, 40 CFR part 191 is the source of these requirements. Section 2.3.3 below considers the potential cost impacts of each of 40 CFR part 194's assurance requirements.

## **Waste Acceptance Criteria**

Section 194.14 requires a description of waste acceptance criteria and the actions taken to ensure adherence to them. The DOE has developed "Waste Acceptance Criteria for the Waste Isolation Pilot Plant," WIPP-DOE-069 (DOE 91c). This document sets forth the requirements that must be met by generator and/or storage sites before TRU waste can be transported to and emplaced in the WIPP. Such requirements refer to containers, waste forms, packaging, and data submission. Section 4.0 of WIPP-DOE-069, "Quality Assurance Requirements," requires each site that generates or stores TRU waste to develop a TRU Waste Certification Program that will perform satisfactorily. Each site's QA program will ensure that only fully-certified waste is shipped to the WIPP. Until certification and QA plans are reviewed and formally approved by DOE pursuant to the Waste Acceptance Criteria (WAC) (WIPP-DOE-069), waste cannot be certified, characterized, transported to, or emplaced in the WIPP. These procedures are required by DOE Orders 5700.6C, "Quality Assurance" (DOE 91b), and 5820.2A, "Radioactive Waste Management" (DOE 88). Therefore, costs associated with waste acceptance criteria are not attributed to 40 CFR part 194.

## **Background Concentrations**

Section 194.14 requires a description of background concentrations of radionuclides in air, soil, and water in the vicinity of the disposal system, including the procedures employed to determine those concentrations. The WIPP Radiological Baseline Program is summarized in the SEIS (DOE 90b), and the history of radiological measurements in the region is also described therein. These measurement programs are extensive and well-documented; it is assumed that the compliance criteria do not call for additional information.

## **Topographic Maps and Meteorologic Conditions**

At least one topographic map of the disposal system vicinity is required. It must clearly show the pattern of surface water flow and the location of active, inactive, and abandoned injection and withdrawal wells in the controlled area and in the vicinity of the disposal system. Several topographical maps, each containing portions of the required data, appear in the EIS (e.g., Figures 4.13 and 4.16 of the SEIS (DOE 80), and Figures 7.8 and 7.23 of the FEIS (DOE 90b)). The presence of these figures suggests that maps incorporating additional characteristics could be generated with little difficulty. A description of past and current climatologic and meteorologic conditions in the vicinity of the disposal system is also required and could be found in DOE literature.

It should be noted that DOE Order 6430.1A, Section 0200-99 (DOE 89c) and elsewhere, mandates the generation of hydrologic, meteorologic, and other data as required under Subpart B of 40 CFR part 194. Subpart B requires little data generation beyond what has already been generated pursuant to NEPA and DOE Orders.

### **2.2.5 Section 194.15: Content of Compliance Re-certification Application(s)**

According to Section 8(f) of the WIPP LWA, the Secretary of Energy must submit to EPA and the State of New Mexico documentation of continued compliance with 40 CFR part 191 not later than five years after the initial receipt of TRU waste for disposal at the WIPP, and every five years thereafter until the facility is decommissioned. Section 15 of 40 CFR part 194 defines the documentation required by EPA to recertify the WIPP.

The compliance criteria require updates of the most recent application in two general areas: (1) deviations from the previous application (including emplacement of waste since the previous certification or re-certification), and (2) additional data and analyses not included in a previous application. Information submitted in previous applications need not be resubmitted. These requirements impose no significant incremental costs on DOE, since information for these items will be collected in accordance with the WIPP LWA and internal DOE Orders, particularly DOE 5400.1, "General Environmental Protection Program" (DOE 90c).

## **2.3 SUBPART C -- COMPLIANCE CERTIFICATION AND RE-CERTIFICATION**

Subpart C of 40 CFR part 194 contains most of the substantive requirements of the rule and has the greatest potential for imposing incremental costs. This Subpart is divided into four major sections: (1) general requirements; (2) containment requirements; (3) assurance requirements; and (4) individual and ground-water protection requirements.

### **2.3.1 General Requirements**

This section provides guidance on procedures to ensure confidence in the integrity of data and analytical methods employed by DOE. The procedures are necessary to ensure the ability of EPA to determine compliance.

### **2.3.1.1 Section 194.21: Inspections**

This section discusses EPA's intent to conduct inspections of WIPP-related locations, review WIPP-related records, obtain samples, and be granted office space accessible to the disposal system. No significant incremental costs will be generated by this provision.

### **2.3.1.2 Section 194.22: Quality Assurance**

This section discusses quality assurance (QA) requirements, with respect to the establishment of and adherence to a QA program and the assessment of quality characteristics.

*Quality Assurance Program* -- The QA Program must be established and executed for particular activities or information important to the containment of waste in the disposal system, specifically: (1) waste characterization; (2) environmental monitoring, sampling, and analysis; (3) field measurements of geological factors, ground water, meteorology, and topography; (4) computations, codes, models, and methods; (5) elicitation of expert judgment; (6) design of the disposal system; (7) data collection; and (8) other factors important to the containment of waste in the disposal system.

*Data Collected Prior to QA Program* -- Any application for certification of compliance must include information that demonstrates that data and information collected prior to the implementation of the DOE QA program have been qualified in accordance with an alternate methodology, approved by the Agency, that employs one or more of the following methods: peer review, corroborating data, confirmatory testing, or a QA program that is similar in effect to American Society of Mechanical Engineers (ASME) guidelines.



*Quality Indicators* -- Any application must address how data have been assessed for the following quality characteristics: accuracy, precision, representativeness, completeness, and comparability.

DOE is presently guided in the above matters by DOE Order 5700.6C, Quality Assurance (DOE 91b). This Order establishes quality assurance requirements "to ensure that risks and environmental impacts are minimized and that safety, reliability, and performance are maximized through the application of effective management systems commensurate with the risks posed by the facility and its work." Data collection and analysis are specifically included under this Order. The intent of DOE 5700.6C is that Quality Assurance Programs (QAPs) be developed individually for large scale and unique operations. In addition, the WIPP is subject to 40 CFR part 268.6 under the Resource Conservation and Recovery Act (EPA 90c), which requires that quality assurance plans be approved by EPA and specifies data accuracy and reproducibility as quality indicators.

Separate quality assurance plans have been developed for each of the activities or information groups enumerated in 40 CFR part 194 (waste characterization, environmental monitoring, etc.). For example, the DOE's "Waste Acceptance Criteria," WIPP/DOE-069, incorporates a 5700.6C quality assurance program for characterization, while DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements" (DOE 90a), specifically requires that quality assurance requirements be built into effluent and environmental monitoring programs. A series of Sandia Performance Assessment Procedures (PAP) cover other items such as expert judgment, codes, models, and methods (SNL 93a-f).

DOE Order 5700.6C references numerous standards and guides, including: ASME/NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities" (ASME 89a); ASME/NQA-3, "Quality Assurance Program Requirements for the Collection of Scientific and Technical Information for Site Characterization of High-Level Nuclear Waste

Repositories" (ASME 89b); and EPA QAMS 050, "Interim Guidelines and Specifications for Preparing QA Project Plans" (EPA 80). The EPA's 40 CFR part 194 requires the same ASME/NQA procedures as DOE Order 5700.6C. Based on this and other commonalities, it may be expected that DOE would implement quality assurance measures in a manner similar to that required by 40 CFR part 194, even in the absence of the regulation. Therefore, no significant incremental costs are attributed to 40 CFR part 194 in the area of quality assurance.

### **2.3.1.3 Section 194.23: Models and Computer Codes**

Any compliance application is required to include a description of the conceptual models used and plausible, alternative models seriously considered but not used to support the application. In particular the application must address the requirements described below.

*Model and Computer Code Verification* -- Verification covers the entire model hierarchy: conceptual, mathematical, numerical, and computer. The underlying conceptual models must represent possible future states of the disposal system; the mathematical models must incorporate equations and boundary conditions which reasonably represent the mathematical formulation of the conceptual models; the numerical models must provide for stable mathematical solutions; and the computer models must accurately implement the numerical models. In addition, conceptual models must have been subjected to peer review.

*Model and Computer Code Documentation* -- Documentation includes compliance with ASME standards and submission of detailed descriptions of codes, models, and licenses. Data collection procedures, sample runs, benchmarking procedures, and other operations are all to be part of the documentation package.

WIPP Procedure No. PAP-03 (SNL 93d) specifies Parameter Selection Quality Assurance Procedures covering models and codes. In addition, DOE Order 1360.3C, "Information Technology Standards" (DOE 92), specifically incorporates the Federal Information Processing Standards (FIPS) into its operations. The FIPS cover most, if not all, of 40 CFR part 194 requirements, particularly with respect to documentation. For example, FIPS Publication 38, "Guidelines for Documentation of Computer Programs and Automated Data Systems" (NBS 76), covers data accuracy, program validation, users manuals, operations manuals, test planning, and test analysis reporting. DOE's approach to the WIPP appears to follow these guidelines. Sandia National Laboratories' Preliminary Comparison with 40 CFR part 191, Subpart B for the Waste Isolation Pilot Plant (SNL 91) contains a status report of WIPP models and programs relative to the quality assurance process. It categorizes software that satisfies QA requirements for traceability, retrievability, documentation, and verification as "Class A." Even if Class A models and programs were to fall short of ASME standards, the cost involved in bringing them up to standard would not be significant. The models and computer codes section of 40 CFR part 194 should not impose significant incremental costs on DOE.

#### **2.3.1.4 Section 194.24: Waste Characterization**

This section requires that the compliance application identify and assess the characteristics and components of waste proposed for disposal in the disposal system. The application also must explain the exclusion of any waste characteristic or component from the analysis.

*Description--* An application must list and describe the chemical, physical, and radiological composition of all existing waste and, to the extent practicable, of to-be-generated waste.

*Documentation*-- DOE is required to submit documentation substantiating that all waste characteristics influencing the containment of waste in the disposal system have been identified and assessed. Assessed characteristics must include, at a minimum, solubility, formation of colloidal suspensions containing radionuclides, gas production, shear strength, compactability, and synergistic effects. In addition, DOE must document that waste components affecting the waste characteristics have been assessed. Assessed components must include, at a minimum, metals, cellulose, chelating agents, water, and activity in curies by isotope. DOE's application also must include information related to process knowledge, waste loading, and a system of controls to ensure that upper and lower limits for waste components are maintained in accordance with release limits.

Waste characterization is addressed indirectly in the WIPP LWA, Section 16, which states that

No transuranic waste may be transported to or from WIPP, except in packages: (1) the design of which has been certified by the Nuclear Regulatory Commission; and (2) that have been determined by the Nuclear Regulatory Commission to satisfy its quality assurance requirements.

The Nuclear Regulatory Commission (NRC) set forth its certification requirements for waste packages in 10 CFR part 71 (NRC 83). An application for approval must include several elements, including a package description that in turn includes a description of package contents. This step requires identification and determination of maximum radioactivity of radioactive constituents, identification and maximum quantities of fissile constituents, chemical and physical form, and maximum normal operating pressure, as well as other items. Thus, the NRC regulations closely approximate many waste characterization requirements of 40 CFR part 194. As long as these requirements can be met through non-destructive assays and drum radiography, DOE should not have to open and analyze a large

number of TRU waste drums. Assuming that non-intrusive methods are effective and process information is useable, the waste characterization requirements of 40 CFR part 194 should not impose any significant costs above those associated with the NRC regulations.

#### **2.3.1.5 Section 194.25: Future State Assumptions**

This section provides that non-geologic, non-hydrogeologic, and non-climatic conditions shall be considered to remain what they are at the time that the compliance application is prepared. The effects of future geologic, hydrogeologic, and climatic conditions should be considered to the extent practicable. These provisions have no significant cost impact.

#### **2.3.1.6 Section 194.26: Expert Judgment**

Expert judgment may be used to support the compliance application(s) only if data cannot reasonably be obtained through data collection or experimentation. This provision of 40 CFR part 194 limits the extent to which DOE employees or contractors can be used as experts. The provision also addresses the extent to which experts must be fully informed and qualified, how the expert elicitation process should be documented, and how its results may be utilized.

The DOE regulates this process internally under WIPP Procedure No. PAP-06, “Use of Expert Judgment Panel Quality Assurance Procedures” (SNL 93f). This procedure covers many of the same items as 40 CFR part 194, including expert qualification, expert selection, and documentation. For example, PAP-06 selection criteria prohibit the use of DOE employees or contractors, while 40 CFR part 194 allows panels to be composed up to two-thirds by such individuals, depending on the availability of qualified independent experts. In addition, 40 CFR part 194 requires that a minimum of five experts be used for any elicitation panel, unless a documented rationale is provided that explains why fewer than five were

selected. While this subject is not addressed by PAP-06, it has been addressed in practice. Sandia National Laboratories, DOE's scientific advisor on the WIPP, has assembled at least three expert panels: the Future Intrusion Panel, the Science Team Panel, and the Geostatistics Expert Group (see SNL 91). While the smallest of these panels has four members, the three panels together average almost ten members. Although there are differences between the expert judgment requirements of 40 CFR part 194 and PAP-06, these differences do not have the potential to result in significant costs.

#### **2.3.1.7 Section 194.27: Peer Review**

This section requires that peer review be conducted to evaluate: selection and development of conceptual models, waste characterization analyses, and the engineered barriers evaluation required by the rule. Such reviews must be conducted in a manner compatible with NUREG-1297, "Peer Review for High-Level Waste Repositories" (NRC 88).

WIPP Procedure No. PAP-05, "Report Review Quality Assurance Procedures" (SNL 93e), spells out peer review requirements and procedures for the WIPP. This document addresses that same items as NUREG-1297, such as the responsibilities of reviewers, composition of peer review panels, documentation requirements, reports, and reviewer qualifications. There are no apparent significant discrepancies between the requirements of 40 CFR part 194 and PAP-05; thus, no significant incremental costs are attributed to the peer review section of 40 CFR part 194.

### **2.3.2 Containment Requirements**

The containment requirements of 40 CFR part 194 include criteria for complying with the containment requirements found in 40 CFR part 191.13. Compliance must be established through performance assessments that: (1) identify processes and events that might affect the disposal system; (2) examine the effects of such events on the system; and (3) estimate the resulting releases of radionuclides. 40 CFR part 194 describes how such performance assessments should be conducted.

#### **2.3.2.1 Section 194.31: Application of Release Limits**

This section states that the expected curie activity at the time of disposal of the waste shall be used in determining the release limits. The provision imposes no significant incremental costs.

#### **2.3.2.2 Section 194.32: Scope of Performance Assessments**

According to 40 CFR part 191, performance assessments must consider “all significant processes and events that may affect the disposal system,” in order to provide a reasonable expectation that the rule’s limits for radionuclide releases will not be exceeded by the disposal system during the regulatory time frame. 40 CFR part 194 specifies that the significant processes and events to be considered in performance assessments for the WIPP are natural processes and events, deep and shallow drilling, and mining. Assessments of mining effects may be limited to changes in the hydraulic conductivity of the hydrogeologic units of the disposal system from excavation mining for natural resources.

Performance assessments must analyze the effects of activities prior to and shortly after disposal that occur in the vicinity of the disposal system, such as existing boreholes and the development of existing leases. Processes and events with less than one chance in 10,000

of occurring over 10,000 years need not be considered. Because these requirements are derived directly from 40 CFR part 191, no incremental costs associated with them are attributed to 40 CFR part 194.

#### **2.3.2.3 Section 194.33: Consideration of Drilling Events in Performance Assessments**

This section of the compliance criteria identifies assumptions that must be used when assessing the likelihood and consequences of deep and shallow drilling events. The assumptions are described below.

*Deep drilling* -- Deep drilling refers to those drilling events in the Delaware Basin that reach or exceed a depth of 2,150 feet below the surface relative to where such drilling occurred. The frequency and total rate of deep drilling must be calculated by identifying each type of such intrusion in the Delaware Basin over the past 100 years and then summing the drilling rates for each resource.

*Shallow drilling* -- Shallow drilling refers to those drilling events in the Delaware Basin that do not reach a depth of 2,150 feet below the surface relative to where such drilling occurred. The frequency and total rate of shallow drilling must be calculated by identifying each type of such intrusion in the Delaware Basin over the past 100 years and summing the rates for each resource. If justified, DOE may consider only the historical rate of shallow drilling for resources of type and quality similar to those in the controlled area.

This methodology for calculating the intrusion rate differs from the Guidance for Implementation found in Appendix C of 40 CFR part 191. Appendix C states that

The Agency assumes that the likelihood of... inadvertent and intermittent drilling need not be taken to be greater than 30 boreholes per square kilometer of repository area per



10,000 years for geologic repositories in proximity to sedimentary rock formations, or more than 3 boreholes per square kilometer of repository area per 10,000 years for repositories in other geologic formations.

If the results of the methodology in 40 CFR part 194 yield a number of boreholes or activities greater than the maximum number assumed by DOE based on the 1985 guidance (DOE 94), then DOE could face additional costs associated with generating multiple probability-consequence curves. These potential incremental costs are considered in greater detail in Chapter 3. There may also be costs associated with the calculation of historical drilling rates, depending upon the extent to which DOE has already assembled such data prior to the promulgation of 40 CFR part 194, but such costs are not expected to be significant.

#### **2.3.2.4 Section 194.34: Results of Performance Assessments**

This section describes how the results of performance assessments should be represented in the compliance application. Results should be assembled into "complementary cumulative distribution functions" (CCDFs) that represent the probability of exceeding various levels of cumulative release caused by all significant processes and events. 40 CFR part 194 requires that the number of CCDFs generated must be large enough that, at cumulative releases of 1 and 10, the sample maximum exceeds the 99th percentile of the population of CCDFs with a probability of 0.95. Information must be provided demonstrating that there is a 95 percent level of statistical confidence that the mean of the CCDF population meets the requirements of 40 CFR part 191.13(a).

Use of CCDFs to display results of performance assessments is a standard procedure for handling probabilistic analyses that has been utilized frequently by DOE. CCDFs predict

the long-term performance of a disposal system and are generated using Monte-Carlo numerical sampling techniques in combination with mathematical models that estimate the releases of waste from the disposal system for a given future scenario. Each scenario represents one possible collection of natural and man-made processes and events that can affect the disposal system. A specific probability is assigned to each scenario that represents the likelihood of that scenario's occurrence. Next, the releases of waste that would occur due to each scenario are estimated using mathematical equations to represent the effects on the radioactive waste of the different processes and events. The input variables or "parameters" that make up these equations each have a range of possible numerical values, one of which is selected at random for each parameter to generate a "set" of input values. The input values from these sets are then entered into the appropriate mathematical equations, which in turn are used to calculate an estimate of the radionuclides released in each scenario.

Once the size of the release has been calculated, it is paired together with the likelihood of that scenario's occurrence. These pairs of values are used to construct one CCDF. To generate a set of many CCDFs, the above process is repeated, starting with a newly selected set of input values and proceeding. These CCDFs may then be used to compute a mean CCDF. The statistical confidence assigned to the mean CCDF will improve as more CCDFs are generated. Since DOE already is pursuing a mean CCDF as its compliance measure (DOE 94), this section is unlikely to generate significant incremental costs.

### **2.3.3 Assurance Requirements**

This section of the compliance criteria addresses Assurance Requirements found in §191.14(a)-(f).

### **2.3.3.1 Section 194.41: Active Institutional Controls**

Compliance applications must include descriptions of proposed active institutional controls, their locations, and their duration of activity. Active institutional controls are means of controlling access to the site other than passive institutional controls (see below), as well as maintenance or remedial actions at the site. Active institutional controls must be developed in order to satisfy §191.14(a) of 40 CFR part 191; therefore, no significant incremental costs are attributed to 40 CFR part 194.

### **2.3.3.2 Section 194.42: Monitoring**

This section requires that the compliance application contain an analysis of the effects of disposal system parameters on the containment of waste in the disposal system. The results of the analysis are then to be used to develop plans for pre- and post-closure monitoring, in accordance with 40 CFR part 191.14(b). The plans must, at a minimum: identify parameters to be monitored; indicate how each parameter will be used to evaluate the performance of the disposal system; and discuss the duration of monitoring. In addition to the requirements of §191.14(b), consideration of ground-water monitoring is called for in hazardous waste regulations at 40 CFR 264 Subpart F.

DOE has begun to plan its WIPP monitoring program. For example, in 1989 DOE initiated the WIPP Operational Environmental Monitoring Program (OEMP). The OEMP incorporates the requirements for effluent monitoring at DOE facilities specified in Order 5400.1, and replaces the pre-operational monitoring programs that were in effect for many years. It is described in DOE/WIPP 88-025, "Operational Environmental Monitoring Program for the Waste Isolation Pilot Plant" (DOE 89d). Also, parameters for the WIPP currently are being examined by DOE through a number of specific tests, as listed in DOE/WIPP 89-001, "Draft Final Plan for the Waste Isolation Pilot Plant Test Phase: Performance Assessment" (DOE 89a).

The requirement for pre-closure monitoring was established in order to provide a baseline for detecting “substantial and detrimental deviations from expected performance” of the disposal system (40 CFR 191.14(b)). Baseline data is necessary in order to ensure that the Agency will be able to determine, at such time as a re-certification of the WIPP is called for, that no substantial deviations from the pre-closure state of the disposal system have taken place. Any costs associated with pre-closure monitoring are therefore attributable to the disposal regulations. Further, 40 CFR part 194 requires pre-closure monitoring “to the extent practicable,” which by definition includes, inter alia, consideration of cost-effectiveness.

#### **2.3.3.3 Section 194.43: Passive Institutional Controls**

This section specifies that compliance applications must include descriptions of passive institutional controls (PICs), their location, and their expected duration. PICs include permanent markers, public records and archives, regulations regarding land and resource use, and other methods aimed at preserving knowledge about the location, design, and contents of the disposal system. Such information must be generated in accordance with the requirements of 40 CFR part 191.14(c). 40 CFR part 194 also indicates that credit for the use of PICs in the form of reduced likelihood of human intrusion in performance assessments may be allowed for a limited period of time at the Agency’s discretion. Since reducing the likelihood of future human intrusion by a proposed amount corresponding to the predicted effect of the PIC is based on 40 CFR part 191, DOE should not incur significant incremental costs in order to meet the conditions of the final 40 CFR part 194. If the Agency determines that DOE’s justification of the use of PIC credit is inadequate, DOE may have to undertake additional analyses, but such analyses would not result in significant costs.

#### **2.3.3.4 Section 194.44: Engineered Barriers**

40 CFR part 194 implements the requirement in 40 CFR part 191.14(d) that “Disposal systems shall use different types of barriers to isolate [waste] from the accessible

environment. Both engineered and natural barriers shall be included.” 40 CFR part 194 requires that disposal systems incorporate engineered barriers to prevent or substantially delay the movement of water or radionuclides toward the accessible environment. DOE must consider engineered barrier alternatives such as cementation, shredding, super-compaction, incineration, vitrification, improved waste containers, grout and bentonite backfill, metal melting, alternative configurations of waste placement, and alternative disposal system dimensions. The required evaluation of alternatives must consider, to the extent practicable, prevention of migration, occupational exposure, ease of waste removal, transportation risk, uncertainty, public comment, and several other factors.

Other DOE directives, such as DOE/WIPP 91-007, "Evaluation of the Effectiveness and Feasibility of the Waste Isolation Pilot Plant Engineered Alternatives" (DOE 91a) and DOE Order 5820.2A, "Radioactive Waste Management" (DOE 88), are similar in intent to 40 CFR part 194's requirements. For instance, “Radioactive Waste Management” states in its discussion of transuranic waste treatment that "volume reduction techniques such as incineration, compaction, extraction, and shredding, shall be implemented whenever cost-effective and practical," which indicates that cost-effective engineered barrier alternatives would be considered by DOE regardless of 40 CFR part 194. As such, no significant incremental costs are attributed to the engineered barriers section of 40 CFR part 194.

#### **2.3.3.5 Section 194.45: Consideration of the Presence of Resources**

According to 40 CFR part 191.14(e), places to be avoided when selecting disposal sites are those where: (1) there has been mining for resources; (2) there is a reasonable expectation of exploration for scarce or easily accessible resources; or (3) there is a significant concentration of any material that is not widely available from other sources. Resources may be minerals, petroleum or natural gas, valuable geologic formations, and ground waters that are either irreplaceable or vital to the preservation of unique and sensitive ecosystems. Section 191.14(e) states that locations with deposits of such resources should not be used

unless the favorable characteristics of such places compensate for the likelihood of future disturbances related to the presence of resources. 40 CFR part 194 reiterates this condition; thus, no significant costs are attributed to this section of the rule.

#### **2.3.3.6 Section 194.46: Removal of Waste**

This section requires that the compliance application include documentation demonstrating that removal of waste from the disposal system is feasible for a reasonable period of time after disposal. The documentation must include an analysis of the technological feasibility of mining the sealed disposal system, given technology levels at the time a compliance application is prepared. This requirement was derived directly from 40 CFR part 191.14(f); therefore, no costs due to it are attributed to 40 CFR part 194.

#### **2.3.4 Individual and Ground-Water Protection Requirements**

This section is based upon Section 15 and Subpart C of 40 CFR part 191. It sets forth criteria for certifying compliance with individual and ground-water protection standards.

##### **2.3.4.1 Section 194.51: Consideration of Protected Individual**

According to the 40 CFR part 194, compliance assessments should assume that an individual resides at the single geographic point where that individual would be expected to receive the highest dose from radionuclide releases from the disposal system. This assumption is common in risk assessments, and is incorporated in the As Low As Reasonably Achievable (ALARA) process adopted by DOE in Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 93a). It is not expected to lead to significant incremental costs.

##### **2.3.4.2 Section 194.52: Consideration of Exposure Pathways**

This section requires that all potential pathways from the disposal system to individuals be considered in compliance assessments, and that it should be assumed that individuals consume 2 liters per day of drinking water from any underground source in the accessible environment. The 2 liter per day assumption is contained in International Commission on Radiological Protection standards for the "reference man" (ICRP 75), which was adopted by DOE in Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 93a). This Order also specifies that all potential pathways are relevant. Thus, no significant incremental costs are attributed to this provision of 40 CFR part 194.

#### **2.3.4.3 Section 194.53: Consideration of Underground Sources of Drinking Water**

This section requires that all underground sources of drinking water expected to be affected by the disposal system over 10,000 years must be considered in compliance assessments. This section reiterates the requirements of §191.24(a)(1), which state that “disposal systems shall be designed to provide a reasonable expectation that 10,000 years of undisturbed performance after disposal will not cause the levels of radioactivity in any underground source of drinking water to exceed” the stated limits. No significant incremental costs are attributed to this section of 40 CFR part 194.

#### **2.3.4.4 Section 194.54: Scope of Compliance Assessments**

This section of 40 CFR part 194 calls for information that identifies and explains potential and existing processes and events, or sequences of processes and events, that are and are not considered in compliance assessments. Compliance assessments are the analyses conducted to determine compliance with 40 CFR part 191.15 and Subpart C. As such, this section is not expected to result in significant incremental costs.

#### **2.3.4.5 Section 194.55: Results of Compliance Assessments**

This section requires documentation of uncertainty, including probability distributions of uncertain parameter values, in compliance assessments. Compliance applications must display the full range of estimated radiation doses and the full range of estimated radionuclide concentrations. Compliance with the disposal regulations will be based upon a 95 percent level of statistical confidence that the mean and the median of the range of estimated radiation exposures and radionuclide concentrations meet the requirements of section 15 and Subpart C of 40 CFR part 191. Appendix C of 40 CFR part 191 suggests that, when the uncertainties of performance are considered, compliance may be determined by “the mean or median of the appropriate distribution, whichever is higher.” While Appendix C is not a binding regulatory requirement, its guidance has been adopted by DOE (SNL 92a), and current practice appears to follow the intent of 40 CFR part 194. This section is not expected to result in significant incremental costs.

## **2.4 SUBPART D -- PUBLIC PARTICIPATION**

Subpart D contains seven sections, five of which deal with Federal Register notices and two of which deal with the establishment of dockets and other documentation issues. As is the case with Subpart A, these provisions are all procedural in nature and impose no significant incremental costs.

### **2.4.1 Section 194.61: Advance Notice of Proposed Rulemaking for Certification**

This section states EPA's intent to announce receipt of application for certification of compliance and to conduct a compliance rulemaking. There are no significant costs associated with this announcement.



#### **2.4.2 Section 194.62: Notice of Proposed Rulemaking for Certification**

This section states EPA's intent to announce the Administrator's proposed decision and solicit public comments. There are no significant costs associated with this announcement.

#### **2.4.3 Section 194.63: Final Rule for Certification**

This section specifies EPA's intent to announce the final decision on compliance. There are no significant costs associated with this announcement.

#### **2.4.4 Section 194.64: Documentation of Continued Compliance**

This section states EPA's intent to publish notice that documentation of continued compliance has been received. There are no significant costs associated with this announcement.

#### **2.4.5 Section 194.65: Notice of Proposed Rulemaking for Modification or Revocation**

This section establishes EPA's intent to publish its decision for certification of compliance given a significant change made in the disposal system. There are no significant costs associated with this announcement.

#### **2.4.6 Section 194.66: Final Rule for Modification or Revocation**

This section specifies EPA's intent to announce the final decision on modification or revocation of compliance applications. There are no significant costs associated with this announcement.

#### **2.4.7 Section 194.67: Dockets**

EPA will establish WIPP docket in New Mexico and Washington, D.C. No significant costs are associated with this action.

## **CHAPTER 3**

### **POTENTIAL COSTS**

Of the requirements of 40 CFR part 194, only one has the potential to impose significant costs on the WIPP program. This requirement, consideration of drilling events in performance assessments, is examined below. Costs associated with the remaining requirements have been attributed to other regulations, directives, or standards, as summarized in Exhibit 1 below.

#### **3.1 CONSIDERATION OF DRILLING EVENTS IN PERFORMANCE ASSESSMENTS**

The difference between DOE's approach to the calculation of drilling rates to date and that described in 40 CFR part 194 was mentioned in Chapter 2.3.2.3 above. Based on 40 CFR part 191, Appendix C, DOE has assumed as a ceiling the rate of 30 boreholes per square kilometer per 10,000 years for sedimentary rock, and 3 boreholes per square kilometer per 10,000 years for other areas. In contrast, 40 CFR part 194 requires a methodology based on summing the historical rates of deep and shallow drilling for each type of resource over the past one hundred years. It is possible that the required approach may result in a drilling "density" greater than 30, although the exact figure is not known at present.

If DOE fails to demonstrate compliance with the disposal regulations using the drilling rate described in 40 CFR part 194, it would have to reconsider the performance of the WIPP disposal system. If a major redesign of the WIPP facility had to occur in order for the facility to comply with the disposal regulations, it would represent a substantial cost. However, of the performance assessment models considered to date, those regarded as most realistic by DOE (although not most conservative) yield releases more than two orders of magnitude below the EPA release limits established in 40 CFR part 191 (DOE 94). Given these modeling results, it seems unlikely that a change in the drilling rate, as specified by the rule, would be large

enough to cause limits to be exceeded. For this reason, redesign costs have not been attributed to 40 CFR part 194. However, failure to demonstrate compliance would lead DOE to seek alternative input variables, such as additional engineered barriers, in the calculation of CCDFs. This in turn would require further modeling in addition to the extra costs of the engineered barriers.

While there would be costs associated with both additional modeling and engineered barriers, it is highly unlikely that either process would place an unreasonable cost burden on DOE. In the worst case, demonstration of compliance using the methodology in 40 CFR part 194 would cost only marginally more than it would have given DOE's previous set of assumptions. As mentioned in Chapter 1.2 above, DOE produced a cost estimate for demonstrating compliance of about \$29 million; thus, the worst-case cost impact of 40 CFR part 194 would be approximately \$29 million.

Exhibit 1:  
40 CFR part 194 Incremental Cost Summary

		Cost Assessment	
Part 194 Requirement	Related Regulations, Directives and Standards, by reference	Potentially Significant	Non-Significant
Subpart A			
1. Purpose, Scope and Applicability	None		X
2. Definitions	None		X
3. Communications	None		X
4. Conditions of Compliance Certification	None		X
5. Publications Incorporated by Reference	None		X
6. Alternative Provisions	None		X
7. Effective Date	None		X
Subpart B			
1. Completeness and Accuracy of Compliance Applications	None		X
2. Submission of Compliance Applications	None		X
3. Submission of Reference Materials	None		X
4. Content of Compliance Certification Application			
Disposal System Description	DOE 80, 89b, 89c, 90b; CEQ 86		X
System Design Description	DOE 89c; SNL 77		X
Assessment Results and Description of Input Parameters	EPA 85		X
Assurance Requirements for Disposal	EPA 85		X
Waste Acceptance Criteria	DOE 88, 91b, 91c		
Background Concentrations	DOE 90b		X
Topographic Maps, Climatic and Meteorologic Conditions	DOE 80, 89c, 90b		X
5. Content of Compliance Re-certification Application(s)	DOE 90c & 93b		X

Exhibit 1:  
40 CFR part 194 Incremental Cost Summary

		Cost Assessment	
Part 194 Requirement	Related Regulations, Directives and Standards, by reference	Potentially Significant	Non-Significant
Subpart C			
1. General Requirements:			
Inspections	None		X
Quality Assurance	DOE 90a, 91b; EPA 80, 90c; ASME 89a, 89b; SNL 93a-f		X
Models & Computer Codes	DOE 92; NBS 76; Siling 83, SNL 91, 93d		X
Waste Characterization	NRC 83		X
Future State Assumptions	None		X
Expert Judgment	SNL 93f		X
Peer Review	NRC 88; SNL 93e		X
2. Containment Requirements:			
Application of Release Limits	EPA 85		X
Scope of Performance Assessments	EPA 85		X
Consideration of Drilling Events in Performance Assessments	EPA 85; DOE 94	X	
Results of Performance Assessments	EPA 85; DOE 94		X
3. Assurance Requirements:			
Active Institutional Controls	EPA 85		X
Monitoring	EPA 85; DOE 891, 89d		X
Passive Institutional Controls	EPA 85		X
Engineered Barriers	DOE 88; 91a; EPA 85		X
Consideration of the Presence of Resources	EPA 85		X
Removal of Waste	EPA 85		X
4. Individual and Ground-Water Protection Requirements:			
Consideration of Protected Individual	DOE 93a		X

Exhibit 1:  
40 CFR part 194 Incremental Cost Summary

		Cost Assessment	
Part 194 Requirement	Related Regulations, Directives and Standards, by reference	Potentially Significant	Non-Significant
Consideration of Exposure Pathways	DOE 93a; ICRP 75		X
Consideration of Underground Sources of Drinking Water	EPA 85		X
Scope of Compliance Assessments	EPA 85		X
Results of Compliance Assessments	EPA 85; SNL 92a		X
Subpart D			
1. Advance Notice of Proposed Rulemaking for Certification	None		X
2. Notice of Proposed Rulemaking for Certification	None		X
3. Final Rule for Certification	None		X
4. Documentation of Continued Compliance	None		X
5. Notice of Proposed Rulemaking for Modification or Revocation	None		X
6. Final Rule for Modification or Revocation	None		X
7. Dockets	None		X

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